NTSB Forum on Motorcycle Safety

Presentation

Motorcyclists' Personal Protective Equipment

The history and benefits of standards

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Introduction

European manufacturers and distributors of motorcyclists' clothing have some twelve years experience of working to standards; firstly with alternative technical specifications and latterly with published European Standards. The contents and requirements of these standards are based on experience with clothing which has proven capable of withstanding road surface impacts at a variety of speeds, and on common sense.

The standards are too "recent" and the quantity of accredited clothing too small to have yet shown any effect on accident statistics, but a longer term analysis of the growth in use of such clothing, and the consequent effects on minor and some less severe injuries, needs to be maintained.

The two types of motorcyclists' clothing

There are two distinct types of motorcyclists' clothing, both bearing the initials "C.E." In the case of the first group, "CE" means "Conformité Européen" and denotes that the products conform to the requirements of European safety legislation (in the case of motorcyclists' protective clothing, the European Union's Personal Protective Equipment Directive 89/686/EEC [1]). These products are a known quantity, in that they will have been subjected to independent tests and be approved by a certification body

In the case of the second group, however, "ce" means "caveat emptor" - or "buyer beware". Such products are not manufactured to any standard and their capacity to provide protection in a slide along the tarmac is entirely unknown and unproven. This does not automatically mean that all "caveat emptor" clothing is of a poor standard and manufactured from weak materials. In fact, some of it can be very good, but the difficulty for the consumer is being able to distinguish between good, bad and indifferent.

In the US market, the majority of motorcycling apparel falls into the “caveat emptor” category. Impact protectors for the back, shoulders, elbows, hips and knees, bearing “CE” marking and conforming to European Standards, have become established as components of “caveat emptor” products, but fully CE approved clothing appears to have not yet achieved even the niche, specialist status it has attained in Europe.

History of the European Standards

Development of the European Standards for motorcyclists’ protective clothing can be traced back to February 1984, when the Auto Cycle Union (ACU) – the United Kingdom’s governing body for motorcycle sport – first started investigating the feasibility of producing a standard for the clothing worn by competitors in circuit racing. This gained momentum in the late 1980s, following a number of catastrophic failures of suits manufactured by leading brands, which twice compelled the ACU to take the dramatic step of banning those companies’ products from the race tracks. A technical subcommittee was set up to draft a standard, but no sooner had this been finalised than the ACU took the decision not to proceed with implementation.

The reason cited was concerns that the ACU could be held legally accountable were a product conforming to its standard to fail to offer sufficient protection to the wearer. To safeguard the ACU from litigation, it is preferable for them to follow the model they already use with safety helmets, where independent standards exist which the ACU can adopt as their technical criteria for competition use. Unfortunately, no comparable standards for clothing existed at the time.

One of the key members of the ACU subcommittee, Dr. Garth Willson, a trackside doctor, approached the European Commission to enquire if the recently-implemented PPE Directive might provide a mechanism for the development of standards for motorcyclists’ protective clothing. His request reached a Mr. Petrovitch, whose son was said to be an enthusiastic motorcyclist, and so the instruction was issued to establish a technical subcommittee within the European Standards Agency, CEN (Comité Europeen de Normalisation): CEN Technical Committee 162 Working Group 9 (“WG9”).

The first meeting of WG9 took place in the former East Berlin in August 1991. An often-controversial work programme; over the next twelve years the subcommittee developed the following standards:

- EN 1621-1:1997 - Motorcyclists' protective clothing against mechanical impact - Part 1: Requirements and test methods for impact protectors
- EN 1621-2:2003 - Motorcyclists' protective clothing against mechanical impact - Part 2: Motorcyclists' back protectors - Requirements and test methods
- EN 13595:2002 Parts 1 - 4 - Protective clothing for professional motorcyclists - Jackets, trousers and one-piece or divided suits
  - Part 1: General requirements
  - Part 2: Test method for determination of impact abrasion resistance
  - Part 3: Test method for determination of burst strength
  - Part 4: Test method for determination of impact cut resistance
- EN 13594:2002 - Protective gloves for professional motorcycle riders - Requirements and test methods
- EN 13634:2002 - Protective footwear for professional motorcycle riders - Requirements and test methods
- EN 14021:2003 Stone shields for off-road motorcycling suited to protect riders against stones and debris – Requirements and test methods

Further details on these standards, including detailed explanations of the test methodologies, is available at:

http://www.pva-ppe.org.uk/standards.htm#EuropeanStandardsformotorcyclists

Compliance with these standards is entirely voluntary; however, if a manufacturer specifically claims or implies in advertising or literature that their product is intended to provide protection, then it must comply with the requirements of the EU PPE Directive. There is a presumption of conformity with the Directive's Basic Health and Safety Requirements for products which meet the requirements of the common technical benchmarks provided by these standards.

Technical and scientific background to the standards

The majority of the supporting scientific research for the standards was prepared by Dr. Roderick Woods, formerly of the Physiological Laboratory at Cambridge University, England. Dr. Woods had published scientific papers on the subject of motorcyclists' protection from the elements, before turning his attention to the injury mechanisms of accidents. Initial tests used a mannekin, to which items of clothing were fitted, and the mannekin dropped from a moving vehicle at various speeds [2].

Dr. Woods' ongoing research sought to develop a laboratory test method that provided good correlation with the mannekin tests and "real world" motorcycle accidents. This work is reported in "Performance of Protective Clothing: Fifth Volume" [3] and lead to the publication of the Cambridge Standard for Motorcyclists' Clothing" [4], upon which almost the entire content of EN 13595, and many of the requirements in the other standards, are based.

Use of standards

Following the publication of EN 1621-1 in 1997, there has been significant uptake in use of the standard and a considerable number of garments sold feature conforming components; particularly to the shoulders, elbows and knees. Hip protectors are less common, which in my view is because the low-cost, "low-tech" and relatively stiff combinations of materials from which the other components are manufactured often do not lend themselves to use as a comfortable hip protector. Pliable materials contour more readily to the form adopted by the hips, and their relationship of the lower abdomen and upper thighs, when the wearer is sat astride a motorcycle, but are more expensive.

Back protectors conforming to EN 1621-2 have steadily gained a foothold in the market, although it is still possible to find non-conforming products. One observation is that stocks of non-approved "back protectors" have been shipped to countries where the PPE Directive does not apply. In May 2005, I saw a quantity of such products in a distributor's premises in Australia.

Garments meeting the requirements of EN 13595 retain a niche profile in Europe; where the vast majority of garments remain "caveat emptor" products. Despite this, non-approved garments are still marketed using claims they offer protection, in direct contravention of the PPE legislation. A number of manufacturers who have yet to embrace the standards are currently lobbying for a reduction in the stringency of the documents – they would prefer to see the requirements of the standards established at a level their products can meet, rather than representing a benchmark to which those products should aspire.

It defies credibility that the major brands possess neither the budget nor the expertise to develop EN 13595-conforming garments, when small companies and mid-sized distributors have been marketing approved jackets, pants and suits for several years. In fact, Italian brand AlpineStars markets fabric kart racing suits, which the governing body homologates using the test methods described in EN 13595-2 and EN 13595-4, but they do not, to date, market leather and textile motorcycling garments conforming to the standard.

Whilst there are undoubtedly developmental costs involved in producing a conforming range of products, for the major brands such budgets are part of their continuing operation. A small shift of departmental emphasis from the aesthetic to the protective would not require additional funding.

EN 13595 specifies two levels of performance, as follows:

> Level 1: "*Clothing designed to give some protection whilst having the lowest possible weight and ergonomic penalties associated with its use*";
>
> Level 2: "*Clothing providing a moderate level of protection, higher than that provided by level 1. There are, however, weight and restriction penalties in providing this level of protection* ".

The overall performance class is determined by the lowest result achieved in the impact abrasion, impact cut and burst strength tests. A garment achieving level 2 in abrasion resistance and burst strength, but only level 1 in impact cut resistance, can only be claimed to meet level 1.

Level 1 clothing might also be described as providing an appropriate level of protection in low speed accidents, where the duration and distance of the run-out phase (the slide along the tarmac) is shorter. Level 2 clothing might be described as providing a satisfactory level of protection in higher speed falls from a motorcycle, for example on the open road or racetrack, although it might be damaged beyond economic repair in doing so.

The Cambridge Standard for Motorcyclists' Clothing specified a third, higher level of protection, for clothing designed to withstand repeated, high-speed falls, but this was removed from the original draft EN 13595 following lobbying from Italian clothing brands. Leather clothing conforming to the level 3 requirements of the Cambridge Standard is exceptionally robust, and requires a considerable period of time to wear in. It was also intended to encompass the most popular brands of UK-manufactured suits worn by amateur racers. For the road rider, however, level 2 garments probably provide the optimum balance of ergonomic performance and protective performance.

The Cambridge Standard was not withdrawn upon publication of EN 13595, and several companies dual mark their garments as conforming to EN 13595 Level 2 and Cambridge Standard Level 3.

The availability of EN 13595, in parallel with demands for superior "all weather" protective clothing by the UK's police motorcyclists, has motivated a number of interesting developments in textile motorcyclists' clothing technology.

In EN 13595-2 and EN 13595-4 tests, the performance of the materials generally used in conventional textile garments falls substantially below even the lowest requirements of the standard. It is not unusual for test specimens to record less than one half of one second in impact abrasion testing – on a par with new, heavy denim.

Textile garments have been developed, however, which record in excess of 13 seconds in the same tests – above the Cambridge Standard level 3 requirements. Furthermore, these garments are waterproof and feature ventilation for improved comfort in hot weather. In temperatures such as those recently experienced in the UK - from 32 Celsius up to as high as 40 Celsius (90 – 104 Fahrenheit) - for many motorcyclists, there was only one apparent solution: to ride in a minimum of clothing and to forego protection!

I, however, was able to ride my motorcycle, whilst wearing one of these new textile suits, for a distance of 92 miles in relative comfort; knowing that in conventional leather or textile clothing the effects of the heat would have either prevented or significantly affected my ability to use my motorcycle. In winter, the suit provides excellent insulation and has proven 100% waterproof in up to eight hours of continual rain. The all-weather, protective motorcycling suit has arrived, and its abilities are confirmed by experience, not born of hyperbole! The suit is the Halvarssons Safety suit and it has been purchased by the Czech Republic's national police, the Fire Department of Munich, in Germany, and the New Zealand Police.

A detailed explanation of the new motorcyclists' textile clothing technologies can be read in chapter 26 of "Textiles for Protection" (Woodhead Publishing in Textiles) [5].

With footwear, a number of the major brands now market motorcyclists' boots conforming to EN 13634; including AlpineStars, BMW, Hein Gericke, Oxtar and Sidi. Models available include sports and touring variants.

Gloves represent the final product group to meet with the requirements of the applicable standard. At the time of writing, not one conforming product is available in the market, although at least two manufacturers are known to be engaged in development.

Costs of testing

The issue of costs was briefly touched upon above. A conversion into US dollars for the testing fees associated with each product group has been provided as part of the PowerPoint presentation which accompanies this paper. The Sterling equivalence has proven to be within the reach of even owner-operator manufacturing concerns in the UK. For larger manufacturers and distributors, particularly the global brands, the costs will represent a mere fraction of their turnover.

Where to next?

The European Standards are based on a level of best practice which manufacturers globally have adopted and refined over many years. In the standardised tests, good, robust products will always fare well, whilst inferior, weak products will be revealed for what they are.

The American National Standards Institute might be convinced to adapt the standards into its “house style”, and to publish them for the benefit and use of US-based manufacturers and distributors; but with ready made motorcyclists’ clothing being manufactured predominantly in the Far East, would it not be more logical to apply common performance standards globally and to use the European Standards as the basis for a series of International Standards?

In tandem with such steps, it might perhaps be useful to revisit the “Hurt Report” [6] as a regularly-updated work programme, to assess the effects and benefits of use of protective clothing for motorcyclists’ in reducing the severity of or preventing minor injuries, and reducing the severity of some “more than minor” injuries.

Certainly, research into the contribution clothing can make to reducing motorcyclists’ injuries is very much the “poor relative” compared to investment in motorcycle-mounted active and passive safety features. Safety bodies and legislators should seriously consider a redistribution of the relevant budgets. Consideration should also be given to providing incentives to industry, to encourage production of accredited products – possibly in the form of tax breaks or grant-funding schemes – and to consumers, to encourage them to purchase those products – possibly via exemptions from sales tax for a defined period.

Conclusion

The European Standards for motorcyclists’ protective clothing, footwear, gloves and impact protectors provide the *de facto* International benchmark for these product groups. Their requirements are stringent, but realistic and – importantly – achievable, even for small volume manufacturers to adopt. The role and importance of adequate protective clothing in reducing the severity of or preventing the minor injuries, which comprise a significant proportion of reported injuries amongst motorcyclists, is often overlooked in favour of mechanical, environmental and licensing strategies. That balance should be redressed.

References

[1] “Council Directive of 21 December 1989 on the approximation of the laws of the Members States relating to personal protective equipment (89/686/EEC)” (as amended).

[2] Prime, D.M. & Woods, R.I., “Tests on the Protection Afforded by Various Fabrics and Leathers in a Simulated Impact of a Motorcyclist on a Road Surface.” Proceedings of the 1984 International IRCOBI Conference on the Biomechanics of Impacts. IRCOBI, Bron, France 1984.

[3] “Performance of Protective Clothing: Fifth Volume. James S. Johnson and S.Z. Mansdorf, Editors. ASTM Publication Code Number (PCN): 04-012370-55”

[4] “The Cambridge Standard for Motorcyclists Clothing – Part 1: Jackets, Trousers, one-piece suits and two-piece suits intended to provide mechanical protection against some injuries on metalled road surfaces – Issue 2, 12.8.99”

[5] “Textiles for Protection”; available from CRC Press LLC, 6000 Broken Sound Parkway, NW, Suite 300, Boca Raton, FL 33487. CRC order number WP3488. ISBN-10: 0-8493-3488-8.

[6] "The Hurt Report" – “*Motorcycle Accident Cause Factors and Identification of Countermeasures”,* Volume 1: Technical Report, Hurt, H.H., Ouellet, J.V. and Thom, D.R., Traffic Safety Center, University of Southern California, Los Angeles, California 90007, Contract No. DOT HS-5-01160, January 1981 (Final Report). Available from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.